Tonal Aspects of Languages 2016
24-27 May 2016, Buffalo, New York

Phonetic cues to contrastive focus in Standard Colloquial Assamese

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Abstract

In this paper our goal is to investigate the phonetic cues of duration and pitch (F_0) for contrastive focus (henceforth CF) in Standard Colloquial Assamese (henceforth SCA), spoken in the eastern part of Assam. SCA declarative utterances in non-final Phonological phrases (henceforth P-phrase) display rising pitch contours (L*H$_P$) and the final constituent undergoes a smooth fall [1]. When a constituent is contrastively focused it forms a P-phrase with a low pitch accent (L*) and high focus boundary tone annotated with an 'f' immediately preceding it (fH$_P$). It was also observed that phonetic cues such as increased pitch range and final syllable lengthening of focused sequence characterise CF [1]. In the experiment reported in this paper, longer string of sentences are considered with focus on three different constituents in order to observe the pre- and post-focus constituents along with the focused constituent. The results show that a constituent with CF has higher pitch and duration value compared to wide focus baseline; the pre-focus constituents though undergo pitch and duration reduction, the compression level is not statistically significant, and finally the post-focus constituents display a flattened pitch contour.

Index Terms: contrastive focus, intonation, pitch, duration, phonetics, phonology

1. Introduction

SCA is the standard variety of Assamese which is spoken in the eastern part of Assam [2]. In the present study, we have observed in detail how contrastive focus (henceforth CF) phonetically manifests itself in SCA. Although CF has been described variously as identificational focus [3], alternatives focus [4] and contrastive focus [5, 6, 7], we hold that it generates a set of alternatives out of which the focused alternant receives contrastive focus [4, 8, 3]. In our previous study [1], which adopted the intonational framework given in [9] [10] [11] [12] [13] and [14], we showed that SCA focus is similar to Bengali [14] and Hindi [15], in SCA declarative utterances, non-final P-phrases display rising pitch contours (L*H$_P$) and unlike Bengali and Hindi, the final constituent undergoes a smooth fall due to lack of pitch accent and the IP final boundary tone L$_I$. Studies like [16] and [17] illustrate how pitch movements (rise or fall) take place between two segmental landmarks such as syllable onset or offset. In case of SCA, L* aligns with the right CV edge of the first syllable and H$_P$ aligns with the nucleus of the final syllable of the P-phrase. When a constituent receives CF, it forms a P-phrase with a low pitch accent (L*) and high focus boundary tone annotated with an 'f' diacritic (borrowed from Khan [18] [19]) immediately preceding it (fH$_P$). It was further proposed in [1] that high focus boundary tone (fH$_P$) is phonologically different from an ordinary P-phrase boundary tone H$_P$. The motivation for treating fH$_P$ differently from H$_P$ emanates from the lack of tonal variation in the sequence following fH$_P$ which is not observed in case of post H$_P$ constituents unless it is immediately pre-verbal. This proposal was further strengthened by phonetic cues such as increased pitch range and final syllable lengthening of the focused sequence. In a CF initiated P-phrase, the segmental landmarks for L* and fH$_P$ are identical to those in non-final P-phrases. In [1], we considered small database of short sentences which conformed to the normative SOV pattern. However, in the present work we have included longer sentence strings containing four P-words with an objective to test the validity of our previous claims in longer utterances. Longer sentences provide us the scope of observing extended sequences of pre- and post-focus constituents. It enables us to observe sentence initial CF realisation with a post-focus tail containing as many as three P-words. In these sentences, the first two tri-syllabic words are the subject and the object respectively, the third word, which is di-syllabic, is object complement in three occurrences, indirect object in one occurrence and first part of noun-verb complex in one. The final constituent is always a verb.

2. Methodology

The experiment presents the results of a comparison made between four sets of sentences: the first set comprises of all-new sentences and the rest of the three sets contain the same sentences from the first set but uttered with CF on the first, the second and the third constituent respectively. The first utterance is produced in response to the question /*ki hol*/ (what happened?) and for eliciting the rest of the sentence sets, the methodology of sentence correction is adopted. The speaker first produces a neutral/ wide focus utterance, for example, '*nɔgɛnɛ nɔjɔnɔk mala k^{h}uzilɛ*' (Nagen asked Nayan for a garland) which is followed by incorrect responses in the form of echo questions from the data collector in respect of different constituents in the utterance, one mistake at a time. Corresponding to the incorrect response from the recordist, the speaker utters the sentence again with the required correction by emphasizing the correct word with CF on it. Hence, the listener's response '*nɔgɛnɛ mrigenɔk mala k^{h}uzilɛ?*' (Nagen asked Mrigen a garland?) is revised with CF on /*nɔjɔnɔk*/. The schema of the recording has been presented below.

Ques: [ki hol]
What happen$_{Past}$
What happened?

Spkr: [[nɔgɛnɛ]$_P$ [nɔjɔnɔk]$_P$ [mala]$_P$ k^{h}uzilɛ]$_I$
Nagen$_{Sub}$ Nayan$_{Obj-Ind}$ garland.$_{Obj-Dir}$ ask$_{Past}$
Nagen asked Nayan for a garland.

Ques: [[nɔgɛnɛ]$_P$ [*mrigenɔk*]$_P$ [mala]$_P$ k^{h}uzilɛ]$_I$?
Nagen$_{Sub}$ Mrigen$_{Obj-Ind}$ garland$_{Obj-Dir}$ ask$_{Past}$
Did Nagen ask Mrigen for a garland?

Spkr: [nai nai] [[nɔgɛnɛ]$_P$ **[nɔjɔnɔk]**$_P$ [mala]$_P$ k^{h}uzilɛ]$_I$
No no Nagen$_{Sub}$ Nayan$_{Obj-Ind}$ garland$_{Obj-Dir}$ ask$_{Past}$
No no, Nagen asked Nayan for a garland.

2.1. Subjects

For the data 3 (three) male and 2 (two) female speakers (20 to 30 years old) from Sivasagar District of Assam were recorded in the recording booth of Phonetics and Phonology Lab, Indian Institute of Technology Guwahati. The recording was done

http://dx.doi.org/10.21437/TAL.2016-33

using a Tascam, D-100 PCM recorder in wav format at the sampling rate of 44 KHz with 16bit resolution with the help of a Shure SM10A head-worn microphone. Care was taken so that the recorded utterances were produced at a normal speech rate.

2.2. Data analysis

All constituents have been measured for their pitch and duration values at P-word level using PRAAT [20]. Pitch values are measured at two points in each of the constituent P-words: pitch minimum (F_0 min) and maximum (F_0 max) were measured on the first and the last syllable of each constituent (Motivation: L* and H_P/fH_P are realised on the first and last syllable of a P-phrase respectively). In order to tackle the inter-speaker variation, the extracted values are normalised using the z-score normalisation method [21] [22] [23] as per the following the formula:

$$F0_{norm} = (F0_i - F0_{aver})/s$$

Where
- $F0_I$ = F_0 value of an individual point
- $F0_{aver}$ = average of all the F_0 values in a P-phrase
- s = standard deviation of all F_0 values in a P-phrase

The normalised values are then analysed running a one-way ANOVA test in StataMP13 [24] by taking normalised pitch and duration values as dependent variables and focused status as fixed factor. A sum total of [5(expressions) x 5(speakers) x 4(focus conditions) x3 (iterations)] 300 utterances comprise the current data size. Syllable level pitch values have also been measured to draw the normalised pitch contours so that we have a better visual notion (Figure-4) of the global effect of CF on intonation; for each syllable, F_0 value was measured at 10 points at equal intervals.

3. Findings

3.1. Focused Constituents

The results of the statistical analysis reveal that the focused constituent, irrespective of its position, shows higher pitch range and increased durational values. The pre-focus constituents undergo pitch compression and durational reduction though the values are not statistically significant; however the pitch reduction in the post-focus constituents is significant by a huge margin leading to post-focus deaccentuation. Effects of CF have been elaborated below with reference to the different constituents in the experimented utterances – first, second, third and final word.

3.1.1. First constituent

In Table-1 pitch and durational values of the first constituent have been displayed in First, Second and third constituent focus conditions. In first constituent-focus (henceforth CF1) condition the initial constituent receives CF, and in second constituent focus (henceforth CF2) and third constituent focus (CF3) conditions the first constituent is pre-focus constituent. The table shows that in CF1 condition the first constituent is characterised by significantly higher pitch ($p<0.05$, $F[1, 148] = 109.68$, $p=0.00$) and greater duration ($p<0.05$, $F[1, 148] = 40.23$, $p=0.00$) values. However in CF2 and CF3 conditions, its realisation does not mark a consistently significant departure from the wide focus (henceforth WF) baseline: in CF2 condition ($p>0.05$, $F[1, 148]=1.52$, $p=0.21$) for F_0max and ($p<0.05$, $F[1, 148]=5.31$, $p=0.02$) for duration and in CF3 condition ($p>0.05$, $F[1, 148] = 0.38$, $p=0.54$) for F_0max and ($p>0.05$, $F[1, 148] = 0.10$, $p=0.76$) for duration.

Table 1: First constituent in different CF conditions

FIRST CONSTITUENT		WF		CF		F	p-value
		Mean	Sd	Mean	Sd		
CF_1	Duration	-.16	.85	.76	.94	(1,148) = 40.23	0.00
	F_0 Max	-.26	.76	1.04	.77	(1,148) = 109.68	0.00
	F_0 Min	.15	1.06	-.03	.85	(1,148) = 1.35	0.24
	F_0 Range	-.31	.89	.95	.73	(1,148) = 89.8	0.00
CF_2	Duration	-.16	.85	-.48	.87	(1,148) = 5.31	0.02
	F_0 Max	-.27	.76	-.42	.79	(1,148) = 1.52	0.21
	F_0 Min	.15	1.06	-.21	1.06	(1,148) = 4.44	0.03
	F_0 Range	-.31	.89	-.25	.91	(1,148) = 0.14	0.71
CF_3	Duration	-.16	.85	-.48	.87	(1,148) = 0.10	0.76
	F_0 Max	-.27	.76	-.34	.83	(1,148) = 0.38	0.54
	F_0 Min	.15	1.06	.09	.95	(1,148) = 0.15	0.70
	F_0 Range	-.31	.89	-.39	.76	(1,148) = 0.40	0.53

Table-2 elaborates that the second constituent i.e. the object adopts similar phonetic features such as increased F_0max ($p<0.05$, $F[1, 148] = 70.49$, $p=0.00$) and duration ($p<0.05$, $F[1, 148] = 14.42$, $p=0.00$) values in order to convey its CF status. It is only in CF3 condition that the object is realised as a pre-focus constituent, and it shows similar pitch ($p>0.05$, $F[1, 148] = 1.39$, $p=0.24$) and duration ($p>0.05$, $F[1, 148] = 1.40$, $p=0.24$) values compared to WF baseline. However, when the object is preceded by contrastively focused subject, it undergoes a drastic pitch compression ($p<0.05$, $F[1, 148] = 298.73$, $p=0.00$) and significant duration reduction ($p<0.05$, $F[1, 148] = 8.40$, $p=0.004$).

Table 2 Second constituent in different CF conditions

SECOND CONSTITUENT		WF		CF		F	p-value
		Mean	Sd	Mean	Sd		
CF_1	Duration	.01	.91	-.43	.96	(1,148) = 8.40	0.004
	F_0 Max	.11	.61	-1.30	.35	(1,148) = 298.73	0.00
	F_0 Min	.08	.88	.67	.79	(1,148) = 18.87	0.00
	F_0 Range	.06	.42	-1.33	.28	(1,148) = 555.57	0.00
CF_2	Duration	.01	.90	.57	.10	(1,148) = 14.42	0.00
	F_0 Max	.11	.61	.95	.61	(1,148) = 70.49	0.00
	F_0 Min	.08	.88	-.88	.65	(1,148) = 57.31	0.00
	F_0 Range	.06	.43	1.13	.50	(1,148) = 197.53	0.00
CF_3	Duration	.01	.91	-.16	.93	(1,148) = 1.39	0.24
	F_0 Max	.11	.61	.23	.64	(1,148) = 1.40	0.24
	F_0 Min	.08	.88	.11	.94	(1,148) = 0.05	0.83
	F_0 Range	.06	.42	.14	.57	(1,148) = 1.03	0.31

3.1.3. Third constituent

CF realisation on the third constituent, which follows the object, further establishes that a constituent with CF is marked by increased F_0max ($p<0.05$, $F[1, 148] = 147.53$, $p=0.00$) and duration ($p<0.05$, $F[1, 148] = 50.71$, $p=0.00$) values in SCA. Moreover, the said constituent is post-focus in both CF1 and CF2 conditions and thus exhibits a sweeping pitch compression in that position – ($p>0.05$, $F[1, 148] = 109.03$, $p=0.00$) in CF1 condition and ($p>0.05$, $F[1, 148] = 27.86$, $p=0.00$) in CF2 condition; however the durational reduction is not statistically significant – ($p>0.05$, $F[1, 148] = 3.7$, $p=0.06$) in CF1 condition and ($p>0.05$, $F[1, 148] = 0.48$, $p=0.49$) in CF2 condition.

Table 3 Third constituent in different CF conditions

THIRD CONSTITUENT		WF		CF		F	p-value
		Mean	Sd	Mean	Sd		
CF_1	Duration	-.17	.87	-.44	.78	(1,148) = 3.7	0.06
	F_0 Max	.03	.68	-.88	.34	(1,148) = 109.03	0.00
	F_0 Min	.03	.99	-.57	1.01	(1,148) = 13.93	0.00
	F_0 Range	.04	.66	-.59	.52	(1,148) = 42.15	0.00
CF_2	Duration	-.18	.87	-.27	.76	(1,148) = 0.48	0.49
	F_0 Max	.03	.68	-.47	.48	(1,148) = 27.86	0.00
	F_0 Min	.04	.99	.43	.96	(1,148) = 6.32	0.01
	F_0 Range	.04	.66	-.79	.12	(1,148) = 115.05	0.00
CF_3	Duration	-.17	.87	.89	.95	(1,148) = 50.71	0.00
	F_0 Max	.03	.68	1.32	.61	(1,148) = 147.53	0.00
	F_0 Min	.04	.99	.10	.71	(1,148) = 0.22	0.64
	F_0 Range	.04	.66	1.34	.66	(1,148) = 143.38	0.00

3.2. Focus correlates

As exemplified in the tables above, in SCA, increased pitch and duration are reliable cues to CF. In the following sections CF will be elaborated with reference to these cues.

3.2.1. F_0max

In all the three positions – first, second and third, CF increases the F_0max value of the focused constituent. So far, F_0min has been left out from the discussion. The reason for this is that F_0min do not bear consistent evidence related to the focus design of an IP. Figure-1 graphically displays how F_0max increases considerably in all the three words when focused. The navy, maroon, green and orange bars represent the F_0max values of the first, second, third and final constituents respectively. In CF1 condition, the navy bar goes up significantly ($p<0.05$, $F[1, 148] = 109.68$, $p=0.00$) compared to the navy bar in WF condition. In CF2 and CF3 conditions the maroon ($p<0.05$, $F[1, 148] = 70.49$, $p=0.00$) and the green ($p<0.05$, $F[1, 148] = 147.53$, $p=0.00$) bars go up respectively. Now if we move on to the F_0max values of the post-focus constituents, we clearly see compression in the F_0max values. In CF1 condition the maroon and the green bars, representing pitch values of the second and the third words, dip down, and in CF2 condition the green bar goes down. The orange bar representing the final constituent remains unchanged to any of the focus conditions. Though the F_0max value of the pre-focus constituents demonstrates reduction, it is not statistically significant.

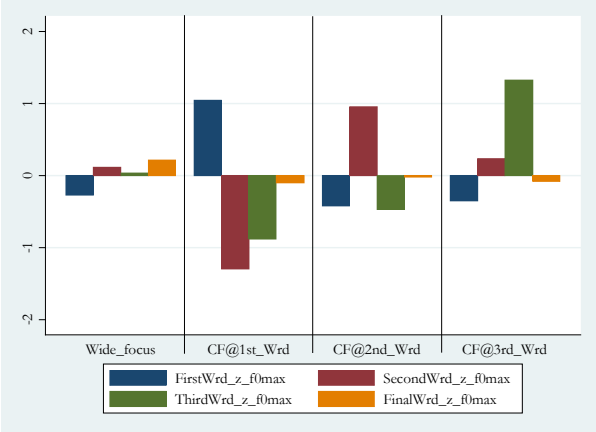

Figure 1 F_0max values in different words and focus condition

3.2.2. Duration

The next phonetic cue found significant in the present experiment is that of the duration of the focused constituent. In Figure-2, the duration bar, compared to WF baseline, increases considerably when the corresponding constituent receives CF, otherwise it is marked by reduction or no change. Identical to the previous chart, in this chart also navy, maroon, green and orange stand for first, second, third and final constituent respectively. In CF1 condition navy ($p<0.05$, $F[1, 148] = 40.23$, $p=0.00$), in CF2 condition maroon ($p<0.05$, $F[1, 148] = 14.42$, $p=0.00$) and in CF3 condition green ($p<0.05$, $F[1, 148] = 50.71$, $p=0.00$) bars demonstrate significantly higher duration values. Though most of the time pre- and post-focus constituents show durational reduction, it is marked by consistency and irregularity.

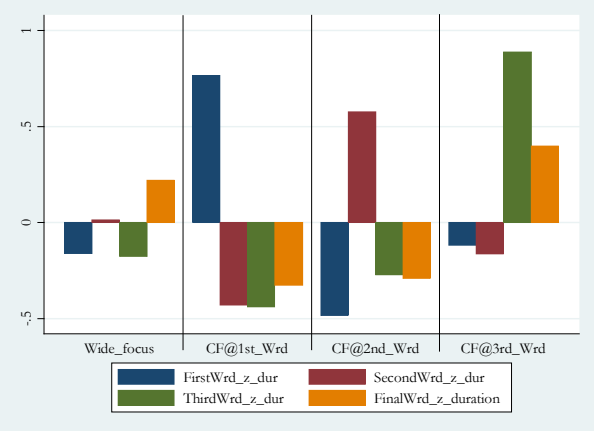

Figure 2 Duration values in different words and focus conditions

3.2.3. Final lengthening

Duration has further been measured on the final syllable of each of the pre-verbal constituents under four different focus conditions with an intention to examine the effect of CF on the final syllable of these constituents. In our previous study [1], it was found that the duration of the final syllable of focused constituent increases significantly, indicating final lengthening. However, in the present corpora, the final syllable of the first and second constituents do not undergo lengthening in the CF condition when compared to the WF baseline. It is only in case of the third constituent that durational length of the final syllable is significantly longer in CF realisation than in WF condition. The z-score normalised duration values of the final syllable in each of the three words are presented in the form of a chart in Figure-3. Since the third constituent shows statistically significant final syllable lengthening in CF condition compared to its WF rendering, only the F-statistics and p-value of the said constituent has been displayed in Figure-3. The statistical values relating to rest of the constituents are not mentioned in the chart as they do not exhibit significant final lengthening in CF condition.

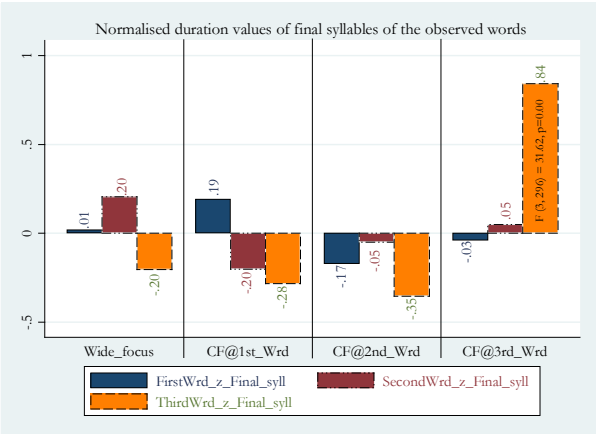

Figure 3 Nomalised final syllable duration values of three words in different focus conditions

The first two constituents produce results which seem to go against our claims in the previous study about final lengthening in CF consituents. There is one difference which stands out prominently (out of several) between the two experiments; in our previous study [1] the target word did not right align with a P-phrase boundary in its WF realisation, whereas in the present study, all the constituents preceding the final constituent form P-phrases in WF condition. In the CF condition, the focused

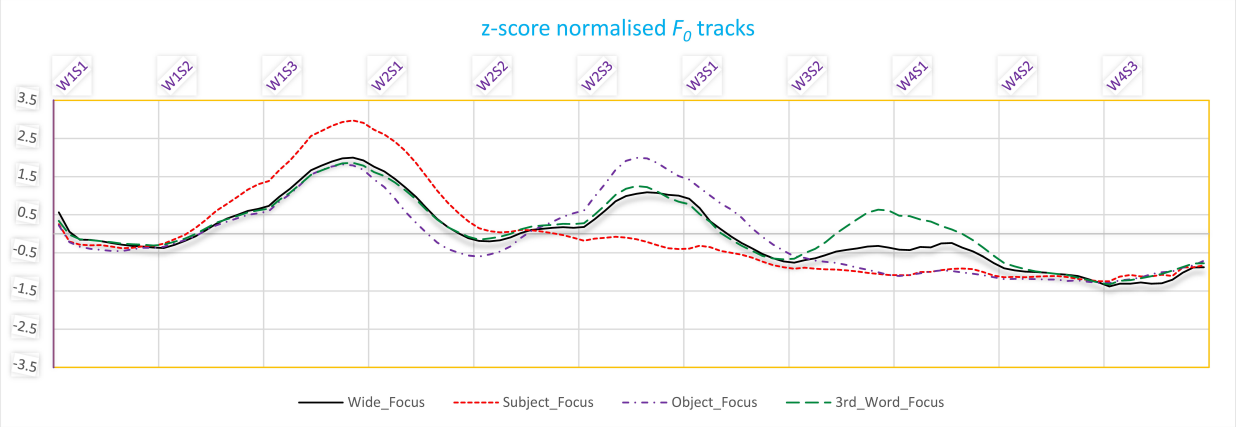

Figure 4 z-score normalised pitch tracks with different focus realisations

constituent is demarcated by focus high boundary tone (fH$_P$) to its right edge resulting in a longer final syllable. Since in the current investigation, all the pre-verbal constituents form P-phrases in WF condition, they are already characterised by phrase level prosodic boundary. Therefore, we assume that the initial two CF induced prosodic phrases do not lengthen the final syllable any further. In spite of the phonetic similarity of these phrases to their WF realisations, they are phonologically different from each other. In case of the third constituent, although the constituent forms a P-phrase and right aligns with a P-phrase boundary in WF context, its manifestation is phonetically compromised; as a consequence, the length of its final syllable is significantly shorter in WF context when compared to its CF context. Therefore, we stick to our previous claim that CF prompts final lengthening on focused constituent and it leads to the formation of P-phrases in the focused constituent. However, if the focused constituent already forms a P-phrase in WF condition, the duration of its final syllable in CF condition may not display significant difference from its WF counterpart. This happens in the first two constituents in the experiment reported here. Furthermore, in comparison with a P-phrase which does not show any lengthening in a WF context due to its occurrence at a later part of an IP, CF induces a final lengthening since it inserts a robust prosodic boundary following it.

4. Discussion

In SCA, CF is characterised by an increased pitch and duration value on the focused constituent. Although duration of the pre- and post-focus constituents does not show a steady departure from the WF reference line, the pitch contour maintains a smooth fall through the post-focus sequence. The intonational contours of the recorded utterances in four different focus conditions have been demonstrated in Figure-4.

The contours of Figure-4 are z-score normalised pitch contours of all the sentences investigated in the present production experiment. The black solid contour represents the WF baseline with a rise on each of the first, second and third constituent words against which the rest of the contours have been compared. The axis on the top specifies the word and syllable number (W1S1 refers to Word-1 Syllable-1 and so forth). The CF1 condition signified by the red dotted line, apart from displaying an exalted pitch excursion on the focused constituent (first word), exhibits how pitch peaks on the second and third constituents are compromised post-focally. The purple contour (with dotted and dashed line) delineates the way the second constituent is focused with an increased pitch peak on the constituent followed by a smooth post-focus fall. The pre-focus sequence almost sustains the pitch trends of the WF baseline. Finally, the contour with green dashes display CF condition with focus on the third constituent. Here again the focused constituent is characterised by greater pitch value; the F$_0$ peaks on the pre-focus constituents are nearly same to those observed in WF condition.

The normalised contours reveal that CF in SCA is marked by higher pitch value on the focused constituent with no consistently significant pitch reduction on the pre-focus constituents. The informational importance of the focused word is further highlighted prosodically with a complete compromise of the pitch rise(s) in the post-focus sequence.

In Figure-4, each of the pitch rises designates a P-phrase. In these phrases, the lowest point aligns with the right edge of the first syllable which is the segmental landmark for the pitch accent L* in SCA. The highest point of the peaks is realised on the nucleus of the final syllable of a prosodic constituent.

5. Conclusion

The findings of the present production experiment confirm our earlier claim [1] that CF initiates increased durational value and greater pitch range on the focused constituent; it further justifies our previous claim of post-focus pitch compression. As far as post-focus pitch compression is concerned SCA behaves similarly to languages like English [25] [26] and Bengali [27] [19], and differently to Hindi [15]; while in the former two languages complete PFC was reported, in the latter one partial PFC has been proposed.

Moreover, durational reduction of the pre-focus constituent(s) which is seen in shorter sentences is not observed in the longer sentences. This provides evidence that when tonal targets are in longer utterances, there are differences in the phonetic implementation of intonation. This does not lead to any difference in the phonologically discrete properties of phrasing which has been reported here and in [1]. Even pre-focus pitch value is not always significantly different from the WF reference line.

Further, this paper provides justification in support of our proposal [1] of treating the focus high tone (fH$_P$) as phonologically different from the high boundary tone (H$_P$) of a non-final P-phrase. The results rationalise that fH$_P$ initiates higher F$_0$ value and it is never followed by another P-phrase level high boundary tone in CF context.

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